**Assessment of berry quality using airborne derived NDVI and PRI in rainfed vineyards**

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**Abstract**

The objective of this study was to evaluate the capability of airborne-derived spectral indices of canopy biophysical

properties (i.e., canopy structure and functioning) at assessing berry quality attributes in vineyards experiencing water

deficits. The study was conducted in rainfed vineyards of *Vitis vinifera* L. cv. Chardonnay. High spatial resolution

multispectral airborne imagery was acquired at veraison over five commercial vineyards. Subsequently, the Normalized

Difference Vegetation Index (NDVI) –a remote indicator of leaf area and fractional absorbed Photosynthetic Active

Radiation – and the Photochemical Reflectance Index (PRI) –an indicator of photosynthetic efficiency– were derived.

Predawn water potential (Ψp) was measured to monitor vine water status on selected vines at each vineyard at the stage

of veraison. At harvest, Berry Weight (BW), Total Soluble Solids (TSS) and Titratable Acidity (TA) were determined

to characterize berry quality. In the year of study, and according to the weather water balance, there was ample water

availability over the vegetative growth period whereas water deficits had a larger incidence from veraison to harvest (P

- ET0 = -153 mm). Predawn water potential ranged from -0.39 ± 0.11 MPa to -0.19 ± 0.01 MPa among vineyards

indicating mild to moderate water stress at the stage of veraison. No significant relationship emerged between Ψp and

NDVI (r2 = 0.51), suggesting that ample water availability over the vegetative growth period led to minor variation in

vine vigor among vineyards. In addition, when the effects of variable canopy structure on PRI were taken into account

(i.e., PRI was normalized by NDVI), a strong relationship emerged between PRI/NDVI and Ψp (r2 = 0.89). These results

suggest that PRI might be a reliable indicator of the water status effects on photosynthetic functioning in these vines

experiencing mild to moderate water deficits. In addition, variation in vine water status led to high variability of fruit

quality at harvest. Airborne-derived spectral indices calculated from the imagery acquired at veraison were variable

related to berry quality attributes. The NDVI and PRI provided complementary information on berry quality attributes.

Thus, NDVI was related to TSS (r2 = 0.81) whereas PRI was related to TA (r2 = 0.67). In addition, while no significant

relationships emerged between NDVI and TSS/TA (r2 = 0.09), PRI provided significant estimates of the maturity index

(TSS/TA; r2 = 0.64) at harvest. The results obtained suggest that remote estimates of photosynthetic functioning through

the PRI might be more appropriate to characterize the effects of mild to moderate water deficits on berry composition

than remote estimates of vine vigor (i.e., NDVI). Therefore, mapping the spatial variability of NDVI and PRI might

provide relevant information to assist in precision viticulture activities such as selective harvesting and ripening

assessment as well as in vine water stress monitoring.

**Keywords:** *Vitis vinifera*, remote sensing, hyperspectral, maturity index, Unmanned Aerial Vehicle

**Assessment of BERRY QUALITY using AIRBORNE derived NDVI and PRI in rainfed vineyards**

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**CONCLUSIONS**

o PRI might be a reliable indicator of water stress in vines experiencing mild to moderate

water deficits.

o Remote estimates of photosynthetic capacity (NDVI) and photosynthetic functioning

(PRI) at veraison properly characterized the effects of mild to moderate water deficits

on berry composition at harvest.

o NDVI and PRI provided complementary information on berry quality attributes: NDVI

was a key determinant of TSS whereas PRI was related to TA and maturity index

(TSS/TA) at harvest.

o Maps of the spatial variability of NDVI and PRI might provide relevant information to

assist in precision viticulture activities such as selective harvesting and ripening

assessment as well as in vine water stress monitoring.

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**Remote sensing applications in precision agriculture**